EFFECTIVENESS OF MUSCLE ENERGY TECHNIQUE AND ECCENTRIC TRAINING ON HAMSTRING FLEXIBILITY IN ATHLETES - A COMPARITIVE STUDY

DISSERTATION

Submitted for the partial fulfillment of the requirement for the degree of

MASTER OF PHYSIOTHERAPY (MPT)

(Elective-MPT sports**)**

By

Regn.No:271650221

Submitted to:

THE TAMILNADU DR.M.G.R MEDICAL UNIVERSITY

CHENNAI–600032.

APRIL - 2018

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144/1, Nungambakkam High Road,

Nungambakkam , Chennai–600034.

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Nungambakkam, Chennai – 600 034.

This is to certify that the Dissertation entitled "**EFFECTIVENESS OF MUSCLE ENERGY TECHNIQUE AND ECCENTRIC TRAINING ON HAMSTRING FLEXIBILITY IN ATHLETES"** was done by Bearing Regn.No: **271650221.**This work has been done as a partial fulfillment for the degree of Master of Physiotherapy done at **Mohamed Sathak A.J College of Physiotherapy**, Chennai and submitted in the year April 2018 to **The Tamilnadu Dr. M.G.R Medical University**.

Date:

Place: Chennai

Seal& Signature of Principal

……..…

Prof. R.Radhakrishnan , MPT .,PGDHM.,

Mohamed Sathak A .J College of Physiotherapy

MOHAMED SATHAK A.J COLLEGE OF PHYSIOTHERAPY

Nungambakkam, Chennai–600034.

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Date:

Place: Chennai Signature of Guide

…..

Prof. R. Radhakrishnan, MPT.,PGDHM.

Mohamed Sathak A.J College of Physiotherapy

CERTIFICATE

MOHAMED SATHAK A.J COLLEGE OF PHYSIOTHERAPY

Nungambakkam, Chennai–600034.

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…… ……..…….

Internal Examiner External Examiner

Place:

Date:

DECLARATION BY THE CANDIDATE

I here by declare that the Dissertation entitled "**EFFECTIVENESS OF MUSCLE ENERGY TECHNIQUE AND ECCENTRIC TRAINING ON HAMSTRING FLEXIBILITY IN ATHLETES** " was done by me for the partial fulfillment of the requiremen to Master of Physiotherapy degree. The dissertation had been done under the direct supervision and guidance of my Guide at **Mohamed Sathak A.J college of Physiotherapy**, Chennai, and submitted the same during the year April 2018 to **The Tamilnadu Dr. M.G.R Medical University**.

Date :

Place : Chennai

…..…….

Signature of the Candidate

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ABSTRACT

Introduction

The Hamstring muscles are found to be the most prevalent for the tightness in the body. Tightness of these muscles produces decrease range of motion and reduced flexibility of the pelvis, hip and knee joints. Muscle stiffness of the lower extremities and the consequential decrease in joint flexibility are considered to be major etiological factors in musculoskeletal injuries.

Muscle tightness is a limiting factor for optimal physical performance including daily activities and an important intrinsic factor for sports injuries

Purpose of Study

To compare the effectiveness of Muscle energy technique and Eccentric Training on hamstring flexibility in athletes.

Material and Methods

For the study 30 athletes with hamstring tightness were selected. The subjects were treated with Muscle Energy Technique (Group A) and Eccentric Training (Group B). The treatment was given to the athletes for one session with two days of rest .The outcome was measured in terms of Active knee extension test (Popliteal angle) and sit and reach test.

Results

Independent-t test was used to compare the pretest-posttest values between the groups. On comparing the Mean values of Group A and B of both the techniques shows significant increase in

the post test. But Muscle Energy Technique shows highest Mean value which is more effective than Eccentric training at **p < 0.001.**

Conclusion

Muscle Energy Technique is more effective than Eccentric training in improvement of

Hamstring flexibility in healthy athletes.

Keywords

Muscle Energy Technique, Eccentric Training, Active knee extension test and sit and reach test, Hamstring flexibility.

1. INRODUCTION

Running is one of the most popular recreational activity and sporting event throughout the world. Running improves cardiovascular health, increases lean muscle mass and helps to relieve stress, so this is an excellent way to maintain good physical and mental health. But running also can lead to muscle imbalances, tightness which leads to injury. However, it has been said that the most of the athletes suffer musculoskeletal injuries associated with running[1, 2]. Clinically, muscle tightness is believed to be an important cause of injury. Roy and Irvin have suggested that more the athlete runs, the greater the likelihood of developing muscle tightness[3]. Running frequently hypertrophies the hamstring and gastrocnemius muscle groups, with concomitant inflexibility of these muscles[4]. James et al also report that runners have a tendency to be tight in the hamstring and calf muscles[5].

Hamstring tightness, the inability to stretch the muscle through in full range of amplitude. This is a prime mover and stabilizer of body that contains muscle spindle, as its functional unit and golgi tendon organs plays important in determining the length and function of muscular components. Hamstrings (Biceps femoris , Semi tendinosis, semimembranosis) are the long and powerful group of muscles that span the back of the thigh. Tightness of this muscle cause sport related injuries, lumbar spine disorder and general low back pain. So muscle flexibility plays an important role in athletes to prevent the injuries.

Flexibility has been defined as the ability of a muscle to lengthen and allows one joint or more than one joint in a series to move through a range of motion[6]. It is a physical fitness attribute and is often evaluated from the joint range of motion (ROM). Flexibility is considered an essential element of normal biomechanical functioning in sport[8]. The literature reports a number of associated benefits of flexibility including improved athletic performance, reduced injury risk, prevention or reduction of post exercise soreness and improved co-ordination[8]. Some studies have shown that decreased hamstring flexibility is a risk factor for development of patella tendinopathy and patellofemoral pain, hamstring strain injury[9,10] .Worrel et al stated that a "lack of hamstring flexibility was the single most important characteristics of hamstring injuries in athletes.

Muscle energy technique is a manual technique developed by osteopaths that is now used in many different manual therapy professions[20]. Such approach which targets the soft tissues primarily and primarly known as MET[20, 21]. It is claimed to be effective for a variety of purposes including lengthening of shortened muscle, as a lymphatic or venous pump to aid the drainage of fluid or blood and increase the range of motion of a restricted joint[22]. Post isometric relaxation is one form of MET which helps in lengthening of tight hamstring by its contraction and relaxation method. The term post isometric relaxation exercise refers to the effect of the subsequent reduction in tone experienced by a muscle or a group of muscles, after brief periods during which an isometric contraction has been performed.

Eccentric training that allows the muscle to elongate naturally and in its relaxed state this elongation is achieved by having the subjects eccentrically contract the muscle to move the joint through the full available range in slow controlled manner to stretch the agonist muscle group[24]. It is a better training strategy to improve the flexibility and also able to increase in strength and protect against muscle damage[25]. More recently, Nelson and Bandy investigated a flexibility

program which consisted of eccentrically training a muscle through a full range of motion. Previous literature suggests that most injuries occur in the eccentric phase of activity[26]. Hamstring muscles are most commonly injured when working eccentrically while decelerating or landing. Eccentrically training a muscle through a full range of motion, could reduce injury rates, improve athletic performance, and improve flexibility.

2. NEED OF THE STUDY

Good ridge JP stated that Muscle energy technique is basically electro physiological trick to encourage muscle to relax more quickly, and suggests that Muscle energy technique helps in lengthening of tight hamstring by its contraction and relaxation method. Nelson and Bandy, 2004 stated that Eccentric training can be an efficient way to increase flexibility. Hence this study was conducted to find out the best method of increasing muscle length in healthy athletes.

3. AIM AND OBJECTIVES OF THE STUDY

Aim

- To compare the effectiveness of muscle energy technique and eccentric training by Active knee extension and Sit and reach test in athletes.

Objectives of the Study

- To find the effectiveness of muscle energy technique on hamstring flexibility by Active knee extension test and Sit and reach test in athletes.
- To find the effectiveness of eccentric training on hamstring flexibility by Active knee extension test and Sit and reach test in athletes.
- To Compare the effectiveness of muscle energy technique and eccentric training on hamstring flexibility by Active knee extension test and Sit and reach test in athletes.

4. HYPOTHESIS OF THE STUDY

Null Hypothesis (H_o)	There is no significant difference in the effectiveness of Muscle Energy Technique on hamstring flexibility in athletes.
Alternate Hypothesis (H_1)	There is significant difference in the effectiveness of Muscle Energy Technique on hamstring flexibility in athletes.

Null Hypothesis (H_o)	There is no significant difference in the effectiveness of Eccentric Training on hamstring flexibility in athletes.
Alternate Hypothesis (H_1)	There is significant difference in the effectiveness of Eccentric Training on hamstring flexibility in athletes.

5. REVIEW OF LITERATURE

- **Harvard et al, Witvrouw et al, and Johagen et al (2007)** Found that decreased hamstring flexibility is a risk factor for development of patella tendinopathy, patellofemoral pain and hamstrings strain injury.

- **Hopper et al (2005)** Stated that flexibility is considered as an essential element of normal biomechanical functioning in sport.

- **C.D.Weijer et al (2003)** Found that lack of hamstring flexibility was the single most important characteristics of hamstring injuries in athletes.

- **Murphy et al and C.D Weijer et al (2003)** They stated that muscle tissue length is thought to play an important role in efficiency and effectiveness of human movement[38].
- **Magnusson et al (1996)** Demonstrated that increased muscle extensibility was attributed to production of increased torque.

- **Jonhagen et al (1994)** Stated that lack of flexibility has been suggested as a predisposing factor to hamstring Strains.

- **Adel Rashad Ahmed (2011)** Compared the effect of Muscle Energy Technique and Dynamic Stretching on Hamstring Flexibility in Healthy Adults with Twenty healthy male subjects having hamstring tightness were randomly divided into two equal groups. Treatment was given for 6 consecutive days and the outcome was measured using active knee extension test. Range of motion was recorded at baseline, post intervention it was concluded that both the technique improved the hamstring flexibility.

- **Daniel mayorga –vega (2014)** examine the scientific literature on the criterion-related validity of sit-and-reach tests for estimating hamstring and lumbar extensibility. Over all sit ad reach test have a moderate mean criterion –related validity for estimating hamstring extensibility ,but have a low mean validity for estimating lumbar extensibility.

- **Mohd.Waseem et al (2010)** Compared the effects of Muscle energy technique and Eccentric training on popliteal angle, they concluded that both techniques improve the popliteal angle. But Muscle energy technique resulted in maximum improvement as compared to eccentric training on hamstring flexibility.

- **Daniel et al (2007)** Concluded that Eccentric training is a better training strategy to improve the flexibility, increase strength and protect against muscle damage.

- **Daniela Nice Ferreira et al (2007)** They compared the influence of Static stretching and Eccentric training on flexibility of hamstring muscles and concluded that both techniques increased the flexibility, and it was higher in the Eccentric training[63]

- **Nelson RT et al (2006)** Suggested that an eccentric form of hamstring stretching may have a superior immediate effect on flexibility. Eccentric stretching exercises on the other hand may serve a protective role when incorporated into a pregame dynamic warm-up[41].

- **Nelson and Bandy et al (2004)** They stated that eccentric training can be an efficient way to increase flexibility.

- **Cupt .Eric Wilson et al (2003)** Found that in achieving Post isometric relaxation (PIR), the effect of a sustained contraction on the golgi tendon organs seens pivotal, since their

response to isometric contraction seems to be to set the tendon and the muscle to a new length by inhibiting it.

- **Leon C (2001)** Said that there are no contraindications of MET. It is perfectly appropriate to utilize MET in an acute and extremely painful situation, working with minute contractions.

- **Liebenson C (1998)** Suggested that Muscle Energy Technique will be effective in treating muscle tension disorder and stated that it effectively relaxes, stretches, strengthens and reeducates abnormal sensory motor pathway.
- **Bandy W.D (1997)** Suggested that duration of 30 seconds is an effective time of stretching for enhancing the flexibility of the hamstring muscles[44].

- **Philip Green man et al (1996)** suggested that Muscle energy techniques can be used to lengthen a shortend, contracted or spastic muscle to mobilize an articulation with restricted mobility.

- **Oajdosis KR and Lusin et al (1993)** Determined hamstring flexibility through active knee extension test, which has shown to have excellent test- re-test reliability.

- **Sharon Wang.S, Susan I. Whitney et al (1993)** Said that compared with a non running population, the long distance runners tested had less hamstring ROM as measured by the hip flexion with the knee extended, and males had tighter hamstring muscles than females also said that the hamstring muscles on the dominant leg were tighter than hamstrings on the non dominant leg.

- **Gogio P et al (1987)** Demonstrated reliability and validity of goniometric measurements at the knee.

- **Bach et al (1985)** Found that runners had significantly limited hip flexion with the knee extended, compared to the non running group.

- **Ekstrand et al(1982)** Demonstrated reliability of Lower extremity goniometer measurements.

6. METHODOLOGY

6.1 STUDY DESIGN:

- Quasi Experimental design

6.2 STUDY TYPE :

- Comparative study

6.3 SAMPLE SIZE:

The total samples (N) = 30. Samples are selected as per the inclusion and exclusion criteria. They are divided into two groups

- Group A - 15 subjects
- Group B - 15 subjects

6.4 SAMPLING METHOD:

- Convenient sampling

6.5 STUDY SETTING

Clinical setup

6.6 STUDY DURATION

4 WEEKS

6.7 SELECTION CRITERIA

INCLUSION CRITERIA

- Indian male 100 meters athletes
- Age 18 -25 years
- Off season athletes
- Having tightness in hamstring (inability to achieve greater than 160 degree of knee extension with hip at 90 degree of flexion)
- Willing to participate in study

EXCLUSION CRITERIA

- Acute/Chronic back pain
- Hamstring injury
- Visual acute swelling in the region of hamstring muscle
- Subjects already involved in any exercise program of lower extremity
- Soft tissue injury and fracture
- Inflammatory joints
- Arthritic condition
- Subjects with history of hip, knee and ankle surgery

6.8 MATERIALS USED

- Couch
- Universal goniometer
- Black theraband
- Sit and Reach Box
- Stop watch
- Paper
- Pencil
- Eraser

6.9 ASSESSMENT TOOLS

- ACTIVE KNEE EXTENSION TEST
- SIT AND REACH TEST

7. PROCEDURE

Subjects volunteered to participate in the training program were selected based on the selection criteria. A total of 30 male 100 meters runners were selected and divided as two groups A and B with 15 members per group and explained about the study. Informed consent was obtained from the subjects. In this study the subjects in group A were trained with muscle energy technique, subjects in group B were treated with eccentric training. Before each study pre test was conducted.

GROUP A- Consisted of 15 subjects who were trained with Muscle Energy Technique.

GROUP B - Consisted of 15 subjects who were trained with Eccentric Training.

After each treatment session, post test was conducted. The subjects were instructed that they will be excluded from the study in case if they develop any pain or injury in lower limbs or back during the training period and subject discontinued during the training program. In this study none of the subjects were excluded.

7.1 ACTIVE KNEE EXTENSION TEST

Subject was made to lie in supine position with hip flexed 90^0 and knee flexed. A Cross bar was used to maintain the proper position of hip and thigh. The other leg and the pelvis were in neutral position and stabilized by strapping with table.

The fulcrum of the goniometer was centered over the lateral condyle of the femur. Stable arm secured along the thigh using the greater trochanter as a reference. Moveable arm was aligned with the lower leg using the lateral malleolus as a reference.

The hip and knee of the extremity being tested were placed into 90^0 flexion with the anterior aspect. The subject was asked to extend the knee as far as possible until a mild stretch sensation felt by subject. Then the angle of knee extension was measured by goniometer.

Three measurements were taken and an average of these three measurements was the final measurement of Popliteal angle by Active knee extension test. (Russell &william, 2004).

7.2 SIT AND REACH TEST

The subject was made to sit on the floor in long sitting. Shoes should be removed. The soles of the feet are placed flat against the box. Both knees should be locked and pressed flat to the floor while the shoulder in 90^0 forward flexion . The subject were instructed to reach forward along the measuring line as far as possible with ensuring that the hands remain at the same level, not one reaching further forward than the other. After few trials, the subject reaches out and holds that position for at one-two seconds while the distance is recorded. Three measurements were taken and an average of these three measurements was the final measurement of sit and reach test. (Bakirtzoglou.P, 2010)

7.3 MUSCLE ENERGY TECHNIQUE

Subject was made to lie in supine position. Then the knee was extended to the position by the therapist where he first reported any hamstring discomfort or stretch sensation, and moderate isometric contraction (approximately 50% of maximal contraction) of the hamstring muscle elicited for a period of five seconds. Then he was asked to relax the muscle so that the knee was further extended to new barrier. After a period of three seconds of relaxation, the technique was repeated for 5 times of 3 sets with a recovery period of 30 seconds between the sets (Ballantyne F, Fryer G, Mclaughlin P 2003)

FIGURE 1 - MUSCLE ENERGY TECHNIQUE

7.4 ECCENTRIC TRAINING

The subject was made to lie in supine position with the leg fully extended. A- 3feet long piece of black elastic resistance band was wrapped around the heel and the subject hold the ends of the band in each hand. The subject was instructed to keep the opposite knee locked in full extension and the hip in neutral position throughout the entire activity. The subject was then instructed to bring the test hip into full hip flexion by pulling on the resistance band attached with the foot and both arms, making sure that knee remained locked in full extension at all times. Full hip flexion was defined as the position of hip flexion at which a gentle stretch was felt by the subject. As the subject pulled the hip into full flexion with the arms, he was instructed to simultaneously resist the hip flexion by eccentrically contracting the hamstring muscle during the entire range of hip flexion. The subject was instructed to provide activity of the hamstring muscles, so that the entire hip flexion took approximately 5 seconds to complete. Once achieved, this flexed hip position was held for 5 seconds and then the extremity was lowered to the ground (hip extension) by the subject's arms. This procedure was repeated for 5 times of 3 sets without rest between repetitions and 30 seconds of recovery period between the sets (Russell & William, 2004).

FIGURE 2- ECCENTRIC TRAINING

8. DATA ANALYSIS AND INTERPRETATION

The collected data were tabulated and analyzed using statistical package (SPSS version 17). Mean and Standard Deviation were used to assess all the parameters. Paired 't- test' was used to find out the` significant difference among the effectiveness of Muscle Energy Technique on hamstring flexibility by Active knee extension test(popliteal angle) and Sit and reach test in athletes. Paired't-test' was used to find out the significant difference among the effectiveness of eccentric training on hamstring flexibility by Active knee extension test (popliteal angle) and Sit and reach test in athletes. Paired't' test was used to find out the significant difference in improvement between pre and post treatment values of Active knee extension test (popliteal angle) and Sit and reach test within the group.

Formulae:

$$t = \frac{\bar{d}\sqrt{n}}{s}$$

Standard Deviation:

$$S = \sqrt{\frac{\sum d^2 - \frac{(\sum d)^2}{n}}{n-1}}$$

Where,

đ is the calculated mean difference between pre treatment and post treatment values.

S is the standard deviation.

n is the sample size.

TABLE – 1

COMPARISON OF ACTIVE KNEE EXTENSION TEST (POPLITEAL ANGLE) WITHIN GROUP – A BETWEEN PRE & POST TEST VALUES FOR MET

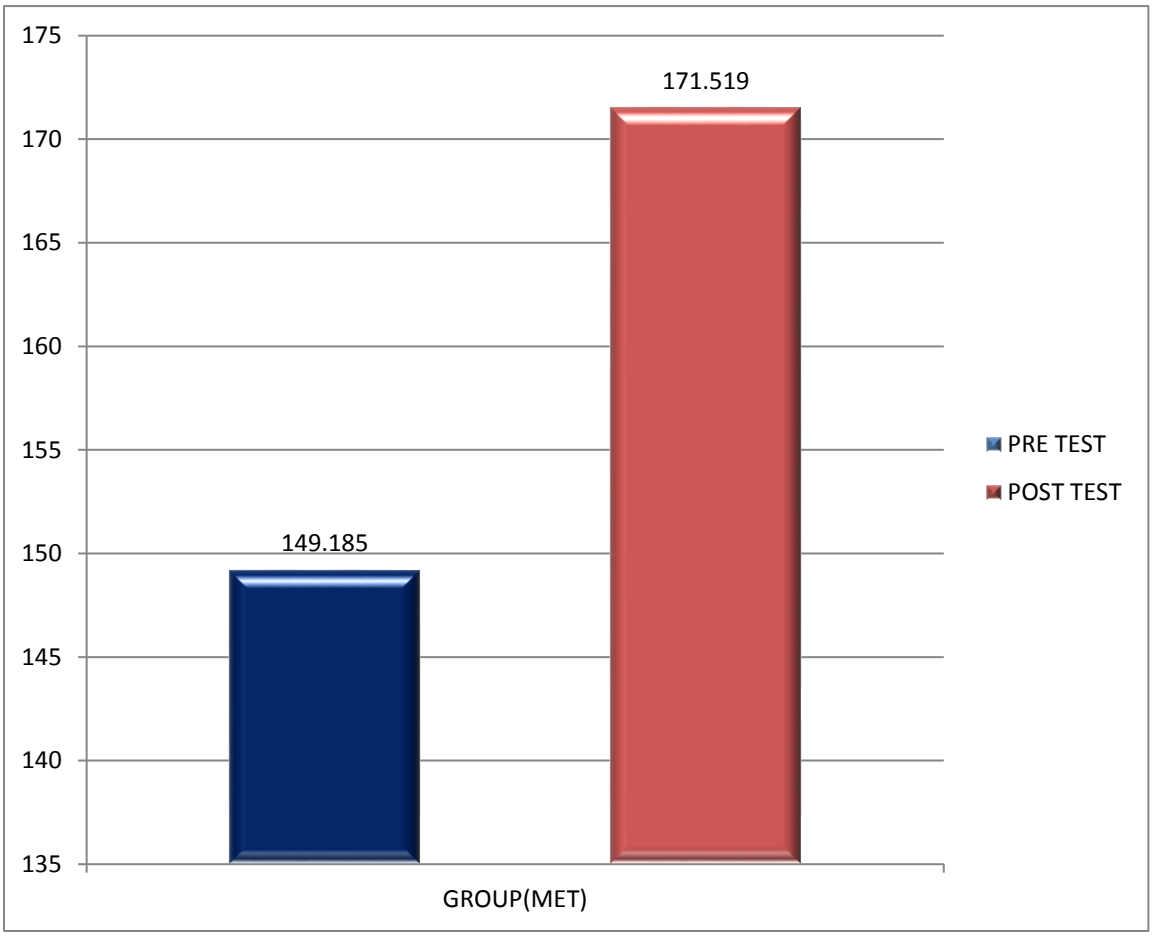
GROUP A	PRE TEST		POST TEST		t-VALUE	SIGNIFICANCE LEVEL
	MEAN	SD	MEAN	SD		
Popliteal Angle	149.185	9.345	171.519	4.438	16.981	.000***

(*- p < 0.001)**

The above table reveals the Mean, Standard Deviation (S.D), t-value and p-value of the ACTIVE KNEE EXTENSION TEST (POPLITEAL ANGLE) between pre-test and post-test for MET within Group – A. In the active knee extension test, there is a significant difference between the pre test and post test values (p***< 0.001).

GRAPH-1

COMPARISON OF PRE TEST AND POST TEST MEANS IN GROUP A MET



Bar diagram shows pre and post test Mean values of Group A. Pre test and post test mean values are 149.185 and 171.519 respectively. This shows that there is improvement of Mean value of Popliteal angle in post test when compared with pre test in MET.

TABLE – 2

COMPARISON OF ACTIVE KNEE EXTENSION TEST (POPLITEAL ANGLE) WITHIN GROUP – B BETWEEN PRE & POST TEST VALUES FOR ECCENTRIC TRAINING

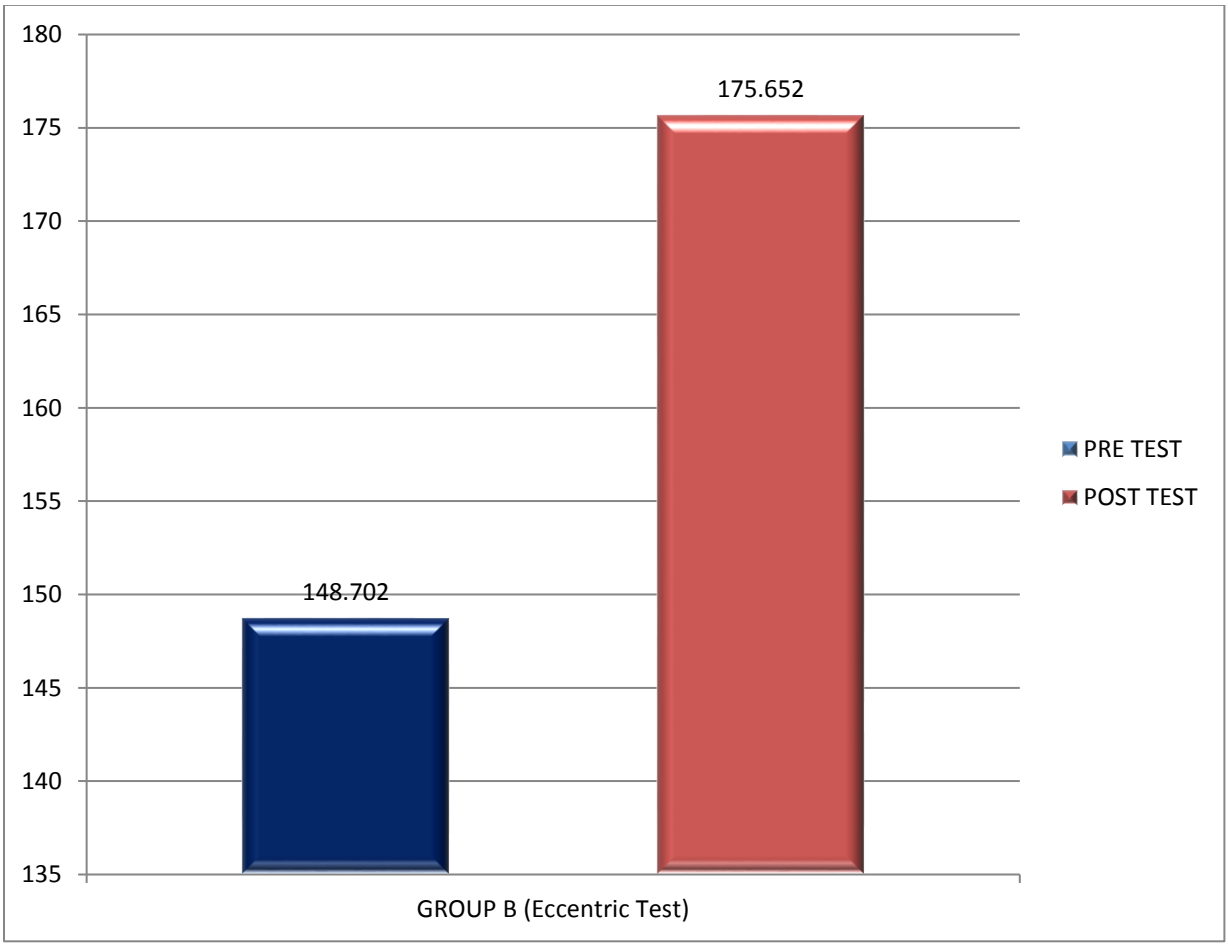
GROUP B	PRE TEST		POST TEST		t-VALUE	SIGNIFICANCE LEVEL
	MEAN	SD	MEAN	SD		
Popliteal Angle	149.602	8.018	185.652	4.773	20.932	.000***

(*- p < 0.001)**

The above table reveals the Mean, Standard Deviation (S.D), t-value and p-value of the ACTIVE KNEE EXTENSION TEST **(**POPLITEAL ANGLE) between pre-test and post-test within Group B for Eccentric Training .In the active knee extension test, there is a significant difference between the pre test and post test values (p***< 0.001) for Eccentric Training.

GRAPH-2

COMPARISON OF PRE TEST AND POST TEST MEANS IN GROUP B ECCENTRIC TEST



Bar diagram shows pre and post test Mean values of Group B. Pre test and post test mean values are 148.702 and 175.652 respectively. This shows that there is improvement of Mean value of ACTIVE KNEE EXTENSION TEST (Popliteal angle) in post test when compared with pre test of group B.

TABLE – 3

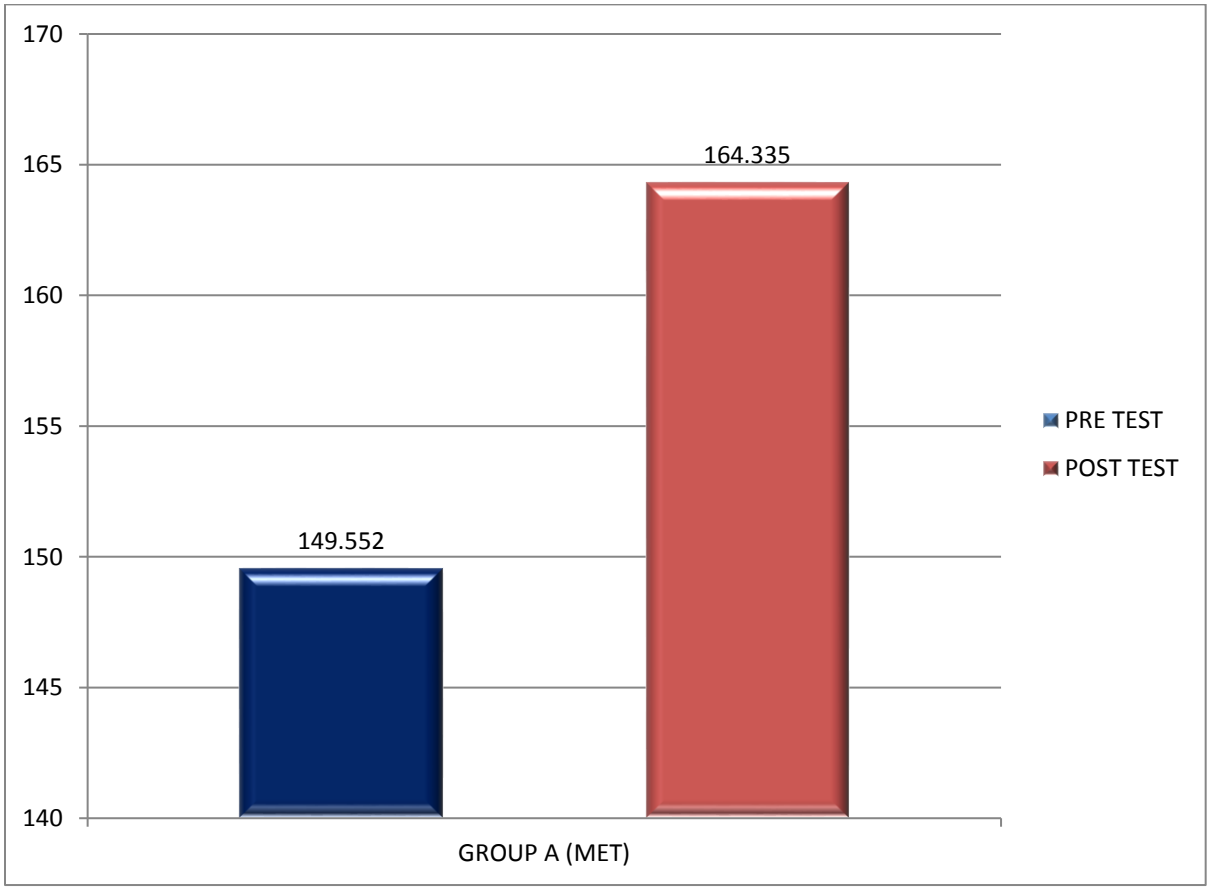
Comparison of sit and reach test within Group – A between Pre & Post test values for MET

GROUP A	PRE TEST		POST TEST		t-VALUE	SIGNIFICANCE LEVEL
	MEAN	SD	MEAN	SD		
Sit and Reach Test	149.552	8.876	164.335	7.533	13.280	.000***

(*- p < 0.001)**

The above table reveals the Mean, Standard Deviation (S.D), t-value and p-value of the pre-test and post-test within Group – A for Sit and reach and test. There is a significant difference between the pre test and post test values of Group A (p***< 0.001) for Sit and reach and test.

GRAPH- 3 COMPARISON OF PRE TEST AND POST TEST MEANS IN GROUP A IN SIT AND REACH TEST FOR MET



Bar diagram shows pre and post test Mean values of Group C. Pre test and post test mean values are 149.552 and 164.335 respectively. This shows that there is improvement of Mean value in post test when compared with pre test for group A (MET).

TABLE – 4

Comparison of sit and reach test within Group – B between Pre & Post test values for Eccentric Training

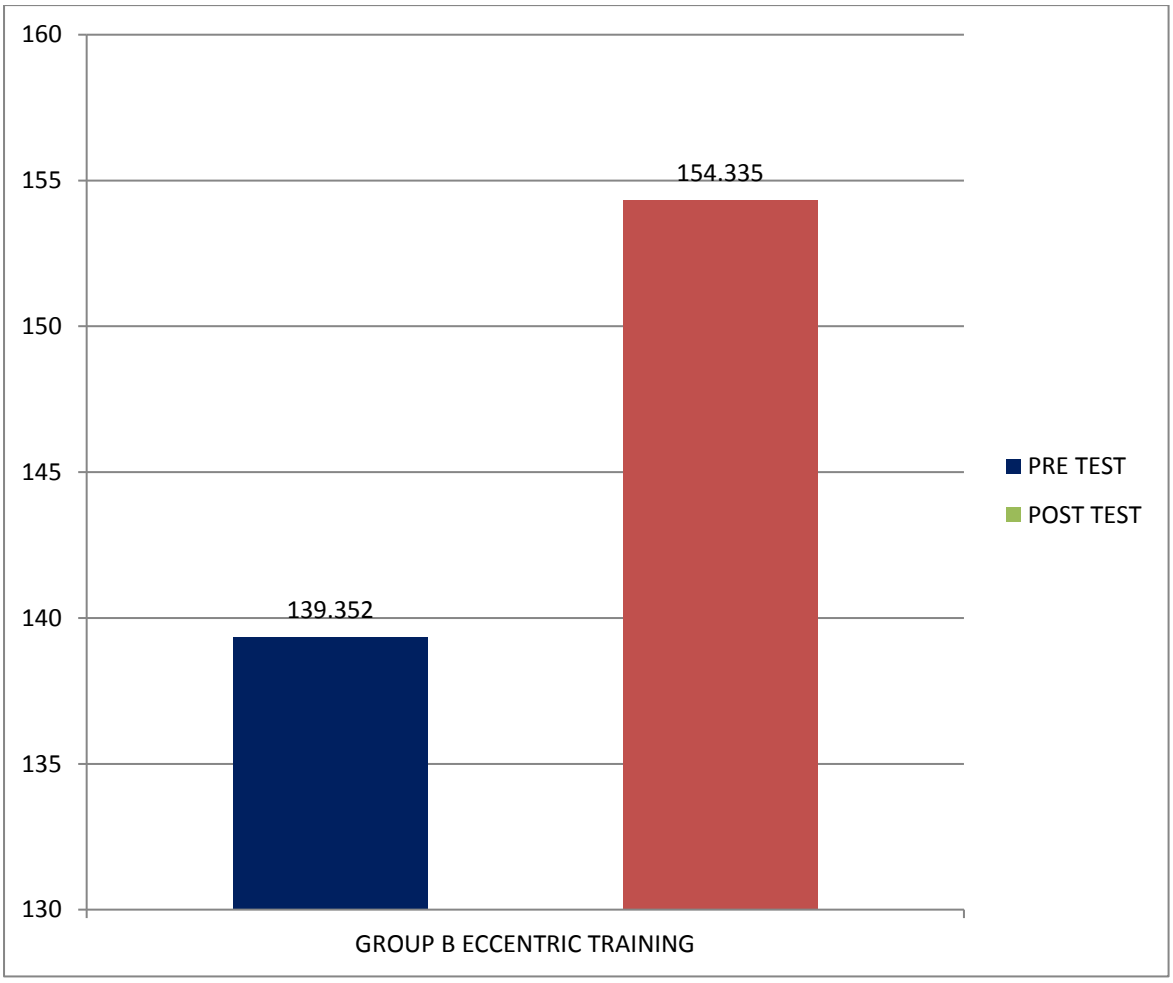
GROUP B	PRE TEST		POST TEST		t-VALUE	SIGNIFICANCE LEVEL
	MEAN	SD	MEAN	SD		
Sit and Reach Test	139.352	7.876	154.335	7.463	13.280	.000***

(*- p < 0.001)**

The above table reveals the Mean, Standard Deviation (S.D), t-value and p-value of the pre-test and post-test within Group – A for Sit and reach and test. There is a significant difference between the pre test and post test values (p***< 0.001) in Sit and reach and test.

GRAPH- 4

COMPARISON OF SIT AND REACH TEST WITHIN GROUP – B BETWEEN PRE & POST TEST VALUES FOR ECCENTRIC TRAINING



Bar diagram shows pre and post test Mean values of Group B. Pre test and post test mean values are 139.352 and 154.335 respectively. This shows that there is improvement of Mean value in Sit and Reach Test in post test when compared with pre test for Eccentric Training

TABLE-5 : COMPARISION ON POST TEST OF MET AND ECCENTRIC TREATMENT BY ACTIVE KNEE EXTENSTION TEST

Measurement	Type of treatment	Mean	SD	t-Test value	Significance
Active Knee Extension Test (Popliteal Angle)	MET	3.133	0.890	2.08	0.001
	Eccentric Training	3.733	1.978		

Inference:

The table shows the comparison of MET and Eccentric Training By Active Knee Extension Test which represents, high significance of MET than Eccentric Treatment by Active knee extension test by the t =2.08 and the significance of $p<0.001$.

TABLE-6 : COMPARISION ON POST TEST OF MET AND ECCENTRIC TREATMENT BY SIT AND REACH TEST

Measurement	Type of treatment	Mean	SD	t-Test value	Significance
Sit and Reach Test	MET	3.065	0.980	2.96	0.000
	Eccentric Training	3.953	1.099		

Inference:

The table shows the comparison of MET and Eccentric Treatment By Active Knee Extension Test which represents, high significance of MET than Eccentric Treatment by Sit and Reach test by the t =2.96 and the significance of $p<0.001$

9. RESULTS

- There is a significant difference in group A pre test and post test values (p***< 0.001) according to Active knee extension test .
- There is a significant difference between the group A pre test and post test values (p***< 0.001) according to the sit and reach test.
- There is a significant difference in the group B pre test and post test values (p***< 0.001) according to the Active knee extension test .
- There is a significant difference between group B pre test and post test values (p***< 0.001) according to the sit and reach test.
- Comparing the results of MET and Eccentric Training By Active Knee Extension Test (Popliteal Angle) by the mean value of MET as 3.133 and SD as 0.890 and the mean value of Eccentric Training as 3.733 and SD as 1.978 . The t-value of the comparing results is 2.08 and P<0.001 . As a result MET is highly significant than Eccentric Training in improving hamstring flexibility in Athletes. Thus athletes treated with MET showed more improvement in hamstring flexibility than the athletes treated with Eccentric Training
- Comparing the results of MET and Eccentric Training by Sit and Reach Test by the mean value of MET as 3.065 and SD as 0.980 and the mean value of Eccentric Training as 3.953 and SD as 1.099 . The t-value of the comparing results is 2.96 and P<0.001 . As a result MET is highly significant than Eccentric Training in improving hamstring flexibility in athletes. Thus athletes treated with MET showed more improvement in hamstring flexibility than the athletes treated with Eccentric Training.

10. DISCUSSION

The review of existing literature regarding the role of different techniques in improving flexibility reveals a confusing picture, so as to which technique out of Muscle Energy Technique and Eccentric training is best for the purpose. Therefore the current study was undertaken to compare the effectiveness among Muscle Energy Technique and Eccentric Training on hamstrings flexibility in healthy athletes and to determine which is best. Hamstring was the muscles of choice since it is the muscle that is most prone to injuries during sporting activities, and if the flexibility of hamstrings is adequate, the incidence of hamstrings strains can be decreased and performance can be enhanced as well. Also there are well documented, reliable and valid methods of testing flexibility of hamstring muscles, such as the Popliteal angle/ Active Knee Extension test and sit and reach test.

A comparison of the pre-test and the post test values of the Active knee extension test and sit and reach test for the groups show that there is a significant improvement among both the group. Thus it may be said that the muscle energy technique and eccentric training are effective individually in improving flexibility of hamstrings.

Muscle Energy Technique (MET) in the present study is comparable to that seen in earlier research. **Ballantyne et al.**[20] identified 30 seconds as the optimal duration for an effective stretch; In MET, muscle elongation, that may produce an increase in muscle length by a combination of creep and plastic change in the connective tissue[22]. The Post isometric relaxation technique (MET) has an effect in increasing joint ROM. This finding is supported by the study conducted by **Leon Chaitow (1994).** In this present study flexibility increase after MET was more (post test Mean- 175.652), whereas Eccentric Training (post test Mean- 164.335) showed less improvement in hamstring flexibility. The mechanism behind the gained flexibility in muscle after MET may be due

to biomechanical, neuro-physiological changes and increase in tolerance to stretch. Whereas static stretching primary effect is focused on reducing tension of muscle and improves the flexibility. However, the mechanism behind the increased flexibility with eccentric hamstring activity through the full range of motion is unclear. Skeletal muscle has a large adaptation potential induced by eccentric contraction and morphological changes are related to the addition of sarcomeres in series[25]. Repeated (eccentric) contraction results in disruption and membrane damage, which in effect leads to uncontrolled Ca++ movements and the development of localized contracture[64]; this could be a cause of less improvement of muscle flexibility in Eccentric training than in Muscle Energy Technique.

Here, our results supported the hypothesis that there is a significant difference among the effectiveness of Static stretching, Muscle energy technique and Eccentric training on hamstring flexibility in healthy athletes.

The result of this study also proved that Muscle Energy Technique may influence on tight muscle and decreases the tightness and increases the flexibility of hamstring than Eccentric training. This result is supported by **Lewit and Simons (1984)**[52] **Leon Chaitow(1994, 2002)**[55] who concluded that MET and its components have significant effects on reducing individual and combination muscle stiffness. Thus our finding has implication in the management of athletes with hamstring tightness.

11. CONCLUSION

On the basis of present study, it can be concluded that Muscle Energy Technique and eccentric training program improves the Hamstring flexibility. Muscle Energy Technique resulted in Maximum improvement when compared to Eccentric training on hamstring flexibility in runners with hamstring tightness.

12. LIMITATIONS

- Only athletes selected for this study.
- The study was done with smaller samples.
- Short duration of the study.
- The results obtained in this study could not be extrapolated to the athletes involved in the other sports.
- Individual's nutrition factors were not controlled.

13. FURTHER RECOMMENDATIONS

Further studies need to be conducted to prove the efficacy of the procedure and techniques involved in this study with

- Female athletes.
- Different Age Groups.
- Larger samples.
- Different fields of players and sports.

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15. APPENDIX

15.1 ASSESSMENT CHART

NAME : DATE:

AGE :

GENDER : male □ female □

SPORT :

1. Playing in competition now yes□ no□
2. Under any Specific Training now yes□ no□

If yes then specify : _____

3. Recent fracture yes□ no□
4. Lower limb / back injury yes□ no□
5. Acute inflammation yes□ no□
6. Hyper mobility of joints yes□ no□
7. Active Knee Extension Test :
8. Sit and Reach Test :

15.2 CONSENT FORM

I, Mr. _____ voluntarily agree to participate in the research study conduct on **"EFFECTIVENESS OF MUSCLE ENERGY TECHNIQUE AND ECCENTRIC TRAINING ON HAMSTRING FLEXIBILITY IN ATHLETES.**" I was explained about the procedure of the study and I understood the requirements and benefit of the study.

I surely solely give consent to participate in the study.

Date: Signature of the Athelete

Place :

Signature of the therapist

15.3 MASTER CHART

ACTIVE KNEE EXTENSION TEST

GROUP A (METS)

S.NO	PRE TEST DEGREE	POST TEST DEGREE
1	144	177
2	142	177
3	146	173
4	157	175
5	153	172
6	152	169
7	148	178
8	148	175
9	147	174
10	152	176
11	138	173
12	135	177
13	136	170
14	140	178
15	137	177

ACTIVE KNEE EXTENSION TEST

GROUP B (ECCENTRIC TRAINING)

S.NO	PRE TEST DEGREE	POST TEST DEGREE
1	145	162
2	149	164
3	150	165
4	151	168
5	152	169
6	147	160
7	147	159
8	149	162
9	150	164
10	153	166
11	150	168
12	152	170
13	148	171
14	146	165
15	150	166

SIT AND REACH TEST

GROUP A (MET)

S.NO	PRE TEST DEGREE	POST TEST DEGREE
1	4	7
2	4.9	8.5
3	4.7	9
4	3.9	7.9
5	6	9.1
6	5.5	8.9
7	6.5	9.2
8	4.4	7.9
9	5	10
10	4.3	8.2
11	3.5	7.1
12	5.1	10
13	6	9.9
14	5.7	9.9
15	5	9.8

SIT AND REACH TEST

GROUP A (ECCENTRIC TRAINING)

S.NO	PRE TEST DEGREE	POST TEST DEGREE
1	5.6	8.9
2	4	7
3	3.5	7
4	4.6	7.8
5	5	8.9
6	5.4	9.9
7	4	8.8
8	5.5	10
9	4.6	7.6
10	3.9	8
11	4.4	9.9
12	3	6.8
13	4.2	9
14	5.1	10
15	3.5	9